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NOTES ON THE CHARACID FISHES OF THE SUBFAMILY SERRASALMINAE[1]

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Introduction

The serrasalmine characins are comparatively well known among South American fishes from several points of view. The ferocity of several of the "piranhas" or "pirayas" of the genus *Serrasalmus* has made these fishes notorious; their attacks upon man are well attested and apparently not infrequent (Eigenmann, 1915, pp. 227-233). On the other hand, the members of the Serrasalminae are themselves used as food, and various aspects of their natural history have entered the literature (Eigenmann and Allen, 1942, pp. 242-245, 252). Certain of the smaller species are also known to aquarists, who have imported them from time to time (Innes, 1942, pp. 160-165).

The limits of the Serrasalminae as here dealt with are those assigned by British authors to the Serrasalmonina (Günther, 1864, p. 366) or Serrasalmoninae[3] (Boulenger, 1904, p. 576; Regan, 1911, p. 17; and Norman, 1929). American authors, on the other hand, have usually followed Eigenmann in breaking up the group into two subfamilies: (1) Serrasalminae *(sensu stricto)*; (2) Mylesinae (Eigenmann, 1903, p. 147), Myleinae

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3. In the time of Boulenger and Regan the type genus was thought to be *Serrasalmo,* the genitive of which would be Serrasalmonis. But Lacépède's original spelling of this genus, though classically incorrect, is *Serrasalmus,* the genitive of which would be Serrasalmi. The subfamily name thus becomes Serrasalminae, not Serrasalmoninae.

(Eigenmann, 1907, p. 772), or Mylinae (Eigenmann, 1910, p. 442). Gregory and Conrad (1938, pp. 321, 325-332) agree neither with Eigenmann nor with the British authors as to the limits of the subfamily, broadening it to include the Stethaprioninae (as well as the Serrasalminae and Mylinae of Eigenmann).

Of the above classifications I can find little basis for that of Gregory and Conrad. These authors give no character or group of characters by which their Serrasalmoninae can be distinguished from other characins, and I know of none. Since Eigenmann's 1907 paper, it has been generally agreed that (p. 771) "the members of the Stethaprioninae mark the direct road from the genus *Tetragonopterus* (Tetragonopterinae) in its narrowest sense to the Myleinae and Serrasalminae." However, I feel that this interpretation is open to question. Aside from a deep body and the sharpening of the midventral edge (which in characins is usually correlated with a deep body), there is only one characteristic common to the Stethaprioninae and a part of the Serrasalminae *(sensu lato)* and that is the very striking development of the predorsal spine. But the predorsal spine of the Stethaprioninae and that of the Serrasalminae are constructed on very different plans (compare Eigenmann, 1917, pl. 98, figs. 5 and 6 with Eigenmann, 1915, pl. 58); the predorsal spine of the Stethaprioninae is movably articulated with the base of the first dorsal ray, whereas that of the Serrasalminae is firmly attached to the first interneural. Furthermore, *Colossoma* and *Mylossoma* of the Serrasalminae lack the predorsal spine, and this seems not to be due to secondary loss.

The recognition of Mylinae as a subfamily equivalent to Serrasalminae (and to such other groups as Tetragonopterinae) appears to me to obscure the close relationship between the two groups. If, however, Serrasalminae is ever raised to family rank, the recognition of two subfamilies might be logical, though the nomenclatorial question would be raised whether the subfamily heretofore called Mylinae would not have become Mylesininae.[4]

The Serrasalminae as here considered, then, may be characterized by the elongate dorsal (of 16 or more rays), by the presence of scutes along at least part of the ventral midline, by the deep body and small scales, and by having a supraorbital bone.

There have been three revisions of parts of the subfamily in recent years. In 1915 Eigenmann wrote a key to the genera, and a key, with synonymies, to the species of *Serrasalmus*. In 1924 Ahl published a revision of the genus *Metynnis*. Norman's paper of 1929 contains a key to the genera, synonymics of all the species of all the genera, and revisions of *Serrasalmus, Colossoma, Mylossoma,* and *Myleus.*

4. If two subfamilies are recognized, it appears that *Catoprion* should be placed as an aberrant offshoot of the Serrasalminae and not with the Mylinae, to which it has hitherto been allocated. Another possibility is to recognize *Catoprion* as constituting a third subfamily.

The purposes of the present paper are (1) to redefine and re-evaluate the genera, determining their phylogenetic relationships insofar as possible; (2) to give a synopsis of the species of *Myleus* (which, as here understood, includes *Myloplus* and *Paramyloplus*); (3) to revise *Metynnis;* (4) to list all the species of the subfamily described since Norman's (1929) paper. Representatives of all of the genera of the subfamily have been examined, including the second known specimen of *Utiaritichthys,* and the first specimen of *Mylesinus* recorded since 1859. A new species, *Acnodon normani,* is described.

Acknowledgments

The basis of the present work lies in the excellent collections of Serrasalminae made by Ternetz on the Rio Tocantins and along the lower Amazon, Brazil, in 1923-1924. This material is now a part of the fish collection of the California Academy of Sciences. I am much indebted to this institution, and particularly to Dr. Wilbert M. Chapman, formerly curator of fishes at the Academy, for the loan of these specimens, and for the very considerable packing and paper work entailed in shipping them. Representatives of the subfamily have been examined in the Museum of Comparative Zoology and the Carnegie Museum through the courtesy and help of Mr. William C. Schroeder and Mrs. M. M. Dick at Cambridge and of Dr. A. W. Henn, Mr. M. Graham Netting, and Dr. Grace Orton at Pittsburgh. I wish also to thank Dr. E. C. Raney and Mrs. M. M. Dick for the loan of specimens from Cornell University and the Museum of Comparative Zoology respectively. Dr. L. P. Schultz has kindly transferred to me specimens loaned to him by the California Academy of Sciences. I am obliged to Mr. Augustín Fernández for sending me a Venezuelan specimen of *Myleus,* and Mr. John W. Winn and Mr. Walter H. Chute have been good enough to give me information concerning specimens of Serrasalminae in Chicago.

Mechanics of the Paper

The synonymies are selected. Those references which do not report new names or new material, and those which record new material which is unidentifiable, are omitted.

Where a tooth formula is given, it is for one side of the mouth only. For example, the notation 5+2/5+1 means that there are five teeth in the outer and two in an inner row on each side above, and five in the outer row with a conical tooth behind the central tooth on each side below. In the suborbital series of bones, the first suborbital or lacrymal borders the nares, and the second suborbital is the first of the exposed cheek series (fig. 5). Splint-like rays at the front of fins are included in fin counts. Following the apparent usage of Norman, Eigenmann, Günther, etc., the last fin ray is included in fin counts if it is well separated from the preceding ray. Scute counts are often divided into two parts, those preceding the insertion of the ventrals and those between the ventral insertion and the anal origin; scutes alongside of the anus are included in the latter; where only a single figure is given, it is the total count.

Measurements, except standard length and depth, were made with dividers and calculated to the nearest 0.1 mm. by laying the divider points along a millimeter ruler. Such measurements were transferred to thousandths of the standard length by slide rule. The standard length, from the tip of the snout to the structural base of the caudal fin, is the only fish length used. The head is measured from the tip of the snout to the end of the bony operculum; the snout, to the anterior border of the orbit; the eye, between the membranes; the snout-dorsal distance, to the base of 1st dorsal ray; the dorsal-caudal distance, from the base of the last dorsal ray to the end of the vertebral column; and the depth of the operculum, between the extreme top and bottom ends of this bone.

The following abbreviations are used: C.A.S. for the California Academy of Sciences, C.M. for the Carnegie Museum, C.U. for Cornell University, M.C.Z. for the Museum of Comparative Zoology, and U.M.M.Z. for the University of Michigan Museum of Zoology.

TABLE 1

Comparisons of various generic characters of the Serrasalminae. Measurements based on a single specimen, those other than standard length expressed in thousandths of standard length.

	Standard length in mm.	Length of lower jaw	Greatest width of third sub-orbital	Depth of body	Length of rayed dorsal base	Length of adipose dorsal base	Bases of rayed and adipose dorsals combined
Colossoma bidens	120	111	42	623	217	50	268
Colossoma nigripinne	165	126	54	582	205	41	246
Mylossoma aureum	112	77	33	698	194	47	241
Mylesinus schomburgkii	205	94	26	513	270	35	305
Utiaritichthys sennae-bragai	168	85	29	601	259	54	332
Myleus setiger	106	97	35	703	309	51	360
Myleus (gurupyensis?)	105	96	30	661	360	31	392
Acnodon normani	114	84	25	553	222	85	307
Metynnis hypsauchen	105	86	36	786	240	193	433
Metynnis argenteus	123	90	33	789	213	173	386
Catoprion mento	103	135	71	657	205	97	301
Pygopristis denticulatus	162	125	67	592	229	75	304
Serrasalmus nattereri	210	163	134	576	248	45	293
Serrasalmus striolatus	116	135	62	614	215	158	372
Serrasalmus elongatus	162	157	62	420	151	35	186

Phylogeny and Classification of Serrasalmine Genera

The following structures seem to be of primary importance in the classification of the genera of Serrasalminae: dentition, scutation of the mid-ventral line, lengths of the dorsal fins, presence or absence of a predorsal spine, and size of the suborbital bones.

All of these characters appear to be correlated with the form and food habits of these fishes. In the genera of Serrasalminae there is a close positive correlation between the length of the lower jaw and the greatest width of the third suborbital (table 1, fig. 1, and fig. 5). That this is a functional correlation is borne out by the jaw musculature. In the characins, the muscles of the lower jaw originate in part on the suspensorium but also in part on the inside surface of the suborbital bones. Other things being equal,

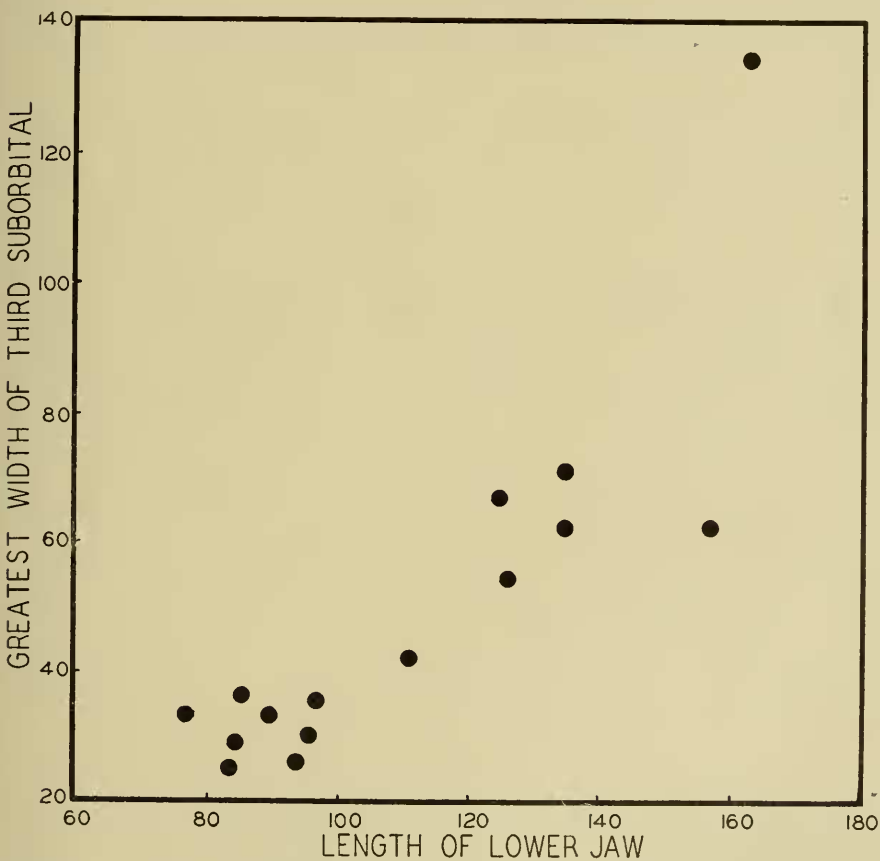

Figure 1. Correlation between length of lower jaw and greatest width of third suborbital in fifteen species of Serrasalminae. Data from table 1. All measurements expressed as thousandths of standard length.

it takes a greater amount of musculature to close the jaw of a long-jawed characin than it does in a short-jawed form. The area for muscle attachment should consequently be greater in the former. But in the Serrasalminae the length of the lower jaw is correlated with food habits, those species with a long jaw being flesh eaters (notably the "piranhas," genus *Serrasalmus)* whereas the short-jawed forms are herbivorous. One exception to this correlation seems to exist, namely the aberrant, long-jawed form, *Catoprion mento,* which, so far as I can determine from the four stomachs examined, eats only fish scales.

The relationship between dentition and food is more obvious. The "piranhas" have a single set of shearing teeth on the premaxillary (fig. 2d) and on the mandible; in some, teeth are also developed on the palatines. In the herbivorous forms there are two rows of teeth on the premaxillary, those of the anterior row being in part conical and those of the rear one being molariform; both rows seem to bite against the flesh of the lower lip. The single main row of teeth in the lower jaw shears chiefly against the inner face of the molariform teeth above. In *Catoprion* both jaws have scattered, tuberculate teeth.

It is not easy to visualize the derivation of the tooth patterns of *Ser-*

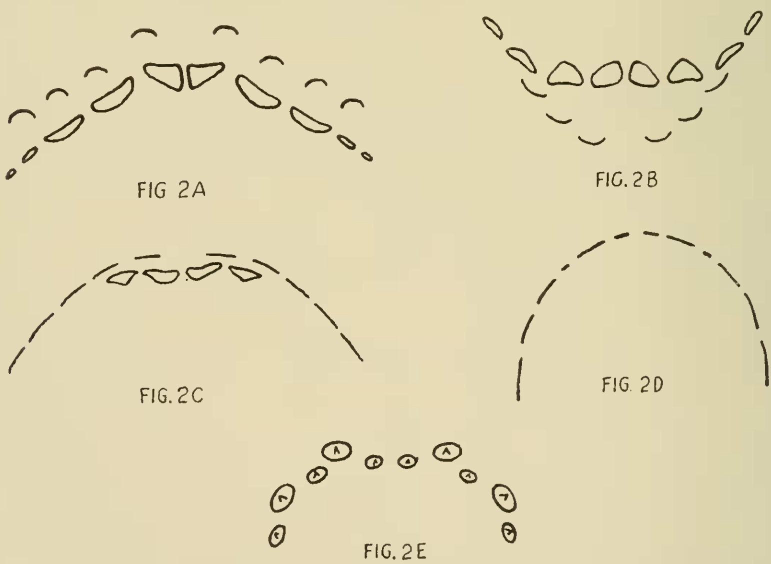

Figure 2. Diagrammatic representation of the dentition of the upper jaw. Open lines depict conical or shearing teeth. Empty closed lines indicate more or less molariform teeth with the shearing surface the inner rim. Carets within closed lines denote tuberculate teeth. All figures are drawn looking up from below. a. *Astyanax bimaculatus* (a tetragonopterine characin); b. *Myleus rhomboidalis;* c. *Mylesinus schomburgkii;* d. *Serrasalmus rhombeus;* e. *Catoprion mento.*

rasalmus, Catoprion, and the herbivorous Serrasalminae from one another, though all are undoubtedly representatives of a single phylogenetic stock. It may be speculated that the herbivorous pattern was derived from the tetragonopterine form (fig. 2a). The front four (probably six) teeth of the outer row appear to have been derived from the tetragonopterine outer row; likewise the four molariform teeth of the inner row seem to be traceable to the tetragonopterine inner row; which row the two outermost teeth on either side came from is not clear. The maxillary teeth, usually present in the Tetragonopterinae, are present among the Serrasalminae only in some species of *Colossoma.* For the "piranhas," it is tempting to suggest that the single row of six teeth on one side of the upper jaw is made up of the seven teeth of the two rows of the herbivores pressed into a single row, with one tooth dropping out (fig. 2d). This seems a logical hypothesis, but I can find nothing for or against it, as there is no tooth pattern intermediate between *Pygopristis* and the herbivores. *Catoprion* again is completely aberrant, showing little affinity for either group (fig. 2e).

In the lower jaw the number of teeth is more variable, and there may be a pair of conical teeth behind the main row at the symphysis. *Pygopristis* and *Serrasalmus* lack conical teeth but usually have seven teeth on one side in front; in the herbivores there are usually five in the front row below on each side plus a conical tooth, but *Mylesinus* and *Colossoma* may have as many as twelve.

Of the taxonomic characters correlated with the deep bodies of the Serrasalminae, the scutation of the midventral line is perhaps the most obvious. A spiniferous midventral surface has arisen several times among the South American soft-rayed fresh-water fishes. It is found in the clupeid *Pristigaster* and in the curimatine characin *Psectrogaster.* Both of these are deep-bodied fishes.

It seems fairly certain that the ventral scutes have arisen from scales. In some species, as in *Colossoma nigripinnis,* which has large scales and small scutes, the number of scutes about equals the number of transverse scale rows. In other genera, however, the scutes are larger and the scales smaller. In some, although the scutes between the ventral and the anal are well developed, those before the pelvics either become gradually indistinguishable forwards (as in *Utiaritichthys)* or are totally wanting (as in *Acnodon).* Whether this absence of scutes forward is primitive or secondary I do not know.

A predorsal spine is found in three subfamilies of South American characins, all deep-bodied, namely the Stethaprioninae, Prochilodinae, and Serrasalminae. The presence of both abdominal scutes and a predorsal spine seems to be most easily explained on the grounds that these are defense structures. It would appear that in a deep-bodied, relatively slow-moving fish, spines at the most dorsal and most ventral parts of the body might mean the difference between fitting and not fitting into the gape of a would-be predator.

The length of the dorsal fin likewise seems to be correlated with the depth of body. The usual number of dorsal rays in characins is 10 to 12. There are several subfamilies of characins that exceed this number, however: Crenuchinae and Serrasalminae in South America; Ichthyoborinae (in part), Distichodontinae (in part), and Citharininae in Africa (according to Boulenger's 1909 classification). Most of these are deep-bodied.

However, a much better correlation between dorsal length and depth of body is to be found within the Serrasalminae. In this subfamily the usual number of dorsal rays is 16 to 18. There is one particularly deep-bodied genus, however, *Myleus,* in which the number of dorsal rays is always more than 20. In another especially deep-bodied genus, *Metynnis,* the rayed dorsal retains its normal length, but the adipose is extremely long. The best corre-

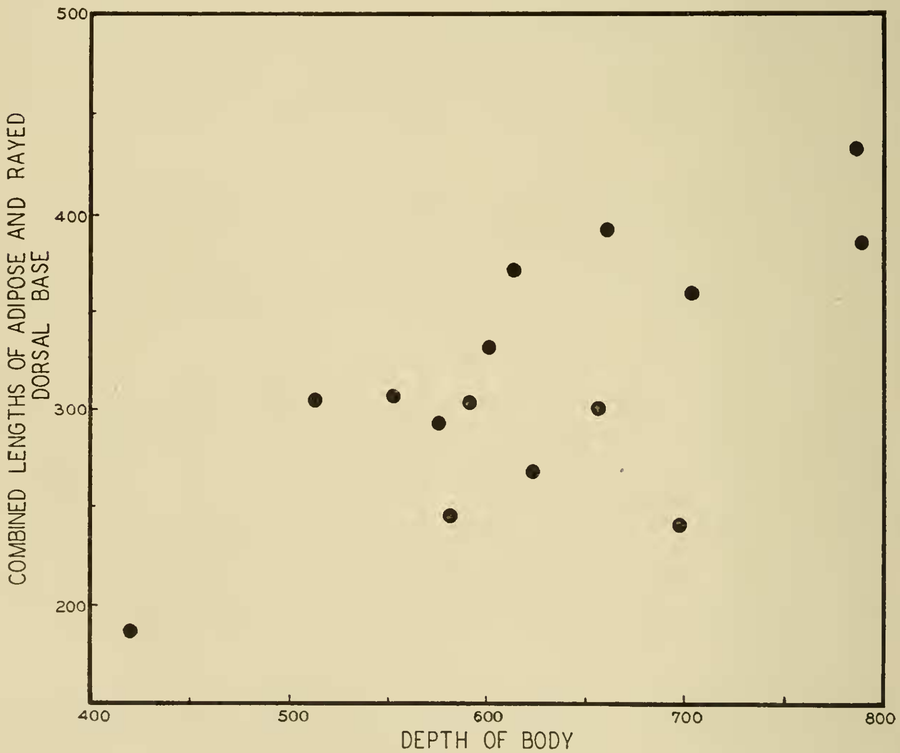

Figure 3. Correlation between depth of body and combined lengths of rayed and adipose dorsals in fifteen species of Serrasalminae. Data from table 1. All measurements expressed as thousandths of standard length.

lation between the depth of the body and the length of dorsal in this subfamily is not to be obtained by plotting the body depth against the length of the rayed dorsal or of the adipose alone, but by correlating depth with the combined lengths of the rayed dorsal and adipose bases (table 1 and fig. 3). This suggests that the adipose not only supplements the rayed dorsal, but that it performs more or less the same function. It is interesting to note in this connection that in some species of two serrasalmine genera, *Serrasalmus* and *Colossoma,* the adipose becomes rayed in the adult.

The phylogenetic diagram here presented (fig. 4) is based chiefly on the characters discussed above. Besides these I know of only two characters of minor importance for serrasalmine generic classification. These are the number of branchiostegal rays and the number of anal rays.

As the diagram is intended to suggest, I believe that there have been about five major lines of specialization in the Serrasalminae. In *Serrasalmus, Pygopristis,* and *Catoprion* the teeth have undergone two different proc-

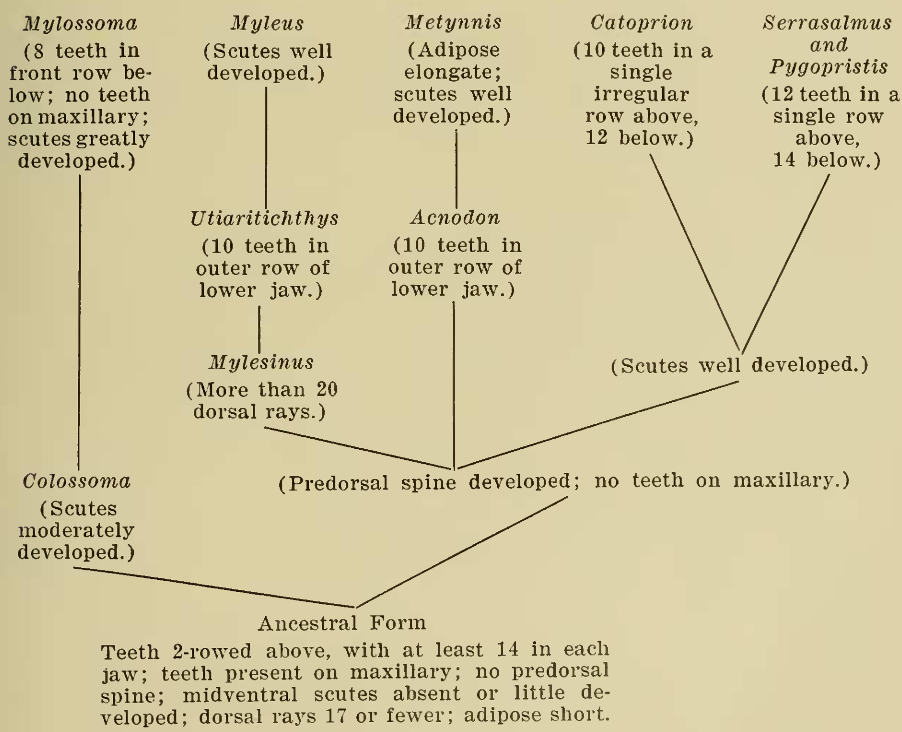

Figure 4. Suggested phylogeny of the genera of Serrasalminae. Characters thought to be present in the serrasalmine ancestor are given at the bottom. Specializations away from the ancestral form are in parentheses. Each genus possesses all those specializations given in the parentheses below it in its own lineage.

esses of modification from the ancestral type; in *Mylossoma* the scutation reaches its highest development in the subfamily; in *Myleus* the dorsal fin has become lengthened; and in *Metynnis* the adipose is longer than in any other serrasalmine genus.

KEY TO THE GENERA OF SERRASALMINAE

1. Teeth in a double row in the upper jaw, 14 in all, the posterior row composed of four molariform teeth (figs. 2b and c); lower jaw short, more or less included 2

— Teeth not in a double row above (figs. 2d and e); lower jaw protruding.... 8

2.(1) Predorsal spine absent. Dorsal with 19 or fewer rays; adipose short-based 3

— Predorsal spine present........ 4

3.(2) Anal short, with 28 or fewer rays; 5 branchiostegal rays; 6 or more teeth on either side of the lower jaw........I. *Colossoma*

— Anal long, with 36 or more rays; 4 branchiostegal rays; 4 teeth on either side of lower jaw........II. *Mylossoma*

4.(2) Seven to 12 teeth on either side of lower jaw. Adipose short-based; dorsal with 21 or 22 rays........III. *Mylesinus*

— Four to 6 teeth in the main row on either side of lower jaw........ 5

5.(4) Anal falcate, bilobed, or trilobed, the posterior rays contained 3 or more times in the longest anterior rays; adipose fin short or moderate, its base less than half the length of the base of the rayed dorsal........ 6

— Anal not falcate and without conspicuous lobes, the last rays more than half as high as longest ray; adipose long, more than half the length of the rayed dorsal base........VII. *Metynnis*

6.(5) At least a few scutes developed ahead of the ventral fins on the midline of the abdomen; dorsal with 20 or more rays........ 7

— Preventral scutes completely lacking on the abdomen; 15-19 dorsal rays. No conical teeth behind central teeth of the main row below....VI. *Acnodon*

7.(6) Only 9 or 10 scutes developed ahead of the ventral bases on the abdominal midline ....IV. *Utiaritichthys*

— Usually 20 or more scutes developed ahead of the ventral bases on the midline of the abdomen........V. *Myleus*

8.(1) Teeth in jaws tuberculate, widely separated, 10 in the upper jaw (fig. 2e) and 12 in the lower; first dorsal rays elongate, the fin falcate........ ....VIII. *Catoprion*

— Teeth in jaws close-set, shearing, 12 in the upper (fig. 2d) and usually 14 in the lower; first dorsal rays not elongate, the fin not falcate........ 9

9.(8) Most of the teeth with 5 (or more) lobes, denticulate........IX. *Pygopristis*

— Teeth trilobed (or simple)........X. *Serrasalmus*

I. Colossoma Eigenmann

Piarctus Eigenmann and Allen, 1942, p. 247 (*lapsus calami* for *Piaractus* Eigenmann). New synonymy, to be added to Norman's generic synonymy.

In several characters (fig. 4) *Colossoma* seems to be the most primitive genus of the Serrasalminae. In other respects, as in the rayed adipose and the more or less ctenoid scales of certain of its species, it is extremely specialized. In regard to still other characters—the comparatively short anal, the presence of 5 branchiostegal rays, and the high number of gill rakers—*Colossoma* may be either primitive or aberrant. In any event, the genus has no close relatives among the Serrasalminae or elsewhere.

Teeth 5+2/6—8+1; upper part of maxillary with teeth in *C. bidens*. Branchiostegal rays 5-5; gill rakers usually numerous, 15-46 below; exposed suborbitals all of about equal depth. Abdominal scutes numerous, 45-69, scales large to small, 60-120. Predorsal spine absent; rayed dorsal with 14-19 rays; adipose short, rayed in adults except in *C. bidens* and *C. oculus;* anal short, with 28 or fewer rays. (Most of these counts are from Norman, 1929.)

Piaractus Eigenmann is often considered a separate genus, but *C. bidens* seems too nearly intermediate between *Colossoma* and *Piaractus* to make this procedure advisable.

Five to seven known species, revised by Norman, 1929. As noted by Eigenmann and Allen (1942, p. 248), *Colossoma* is neuter, and the adjectival specific names in the genus must be given neuter endings.

To the species cited by Norman, add *Colossoma canterai* (Devincenzi) in Devincenzi and Teague, 1942, p. 74, 1 fig. (Río Uruguay). This species is closely related to *C. mitrei.*

II. **Mylossoma** Eigenmann

This genus, although agreeing with *Colossoma* in the absence of a predorsal spine, differs strikingly in several other respects. The individual preventral scutes are the most highly developed of any genus in the Serrasalminae; the teeth in the lower jaw are reduced to 4 on a side; and the body is extremely deep and the anal long. Finally, the air bladder tapers into a cone-shaped projection which extends posteriorly over the base of the interhaemals; in this, *Mylossoma* agrees with the deep-bodied genus *Metynnis,* though it is highly probable that the character has been evolved independently in the two genera.

Teeth 5+2/4+1; no teeth on maxillary. Branchiostegal rays 4-4; gill rakers about 12 below in *M. duriventre;* exposed suborbitals of approximately equal width (fig. 5a). Abdominal scutation greatly projecting, 34-53; scales small. Predorsal spine absent; rayed dorsal with 14-19 rays; adipose short, never rayed; anal count 29-42. (Most of these counts are from Norman, 1929.)

Five known species, revised by Norman (1929). To the synonymy of *M. duriventre* given by Norman (1929, p. 813) add *Mylossoma argenteum* Ahl, 1929, p. 273 (Amazon River). *Mylossoma* is also a neuter name, and its adjectival specific names must be made to agree.

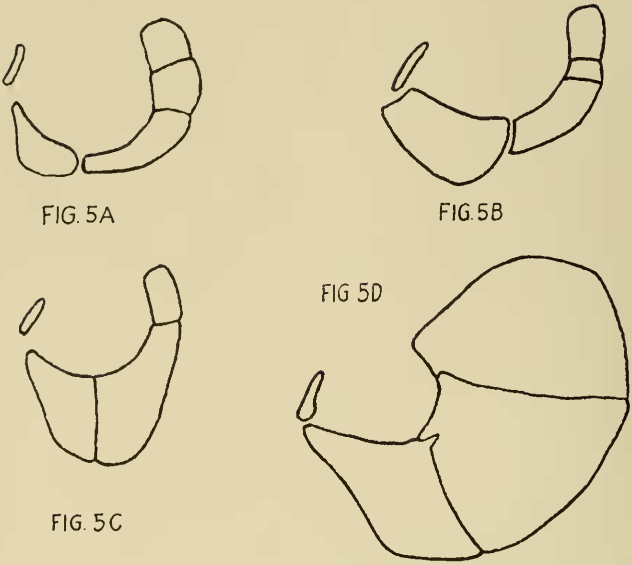

Figure 5. Suborbital bones of various Serrasalminae. a. *Mylossoma duriventre;* b. *Acnodon normani;* c. *Catoprion mento;* d. *Serrasalmus nattereri.* Many specimens of various species of the subfamily may have four exposed suborbital bones on one cheek and three on the other.

III. **Mylesinus** Valenciennes

This genus is easily distinguished from *Myleus,* which it resembles superficially, by the shape of the teeth, by the larger number of teeth in the lower jaw, and by the complete absence of preventral scutes on the abdomen.

There are apparently only three records of this monotypic genus. The original description by Valenciennes (1849, p. 234, pl. 644) was based on a head and a figure of the body of a specimen presumably from the Essequibo River in British Guiana. According to Norman (1929, p. 807), the British Museum is in possession of a badly preserved skin from Demerara, British Guiana. Finally Kner (1859, p. 32, pl. 3, fig. 7) recorded the fish from the Rio Vaupés, a tributary of the Rio Negro in Brazil. For some reason I do not understand, Norman has considered Kner's record, with his redescription and plate, as a misidentification for *Myleus setiger.*

Teeth 5+2/7—12+1; no teeth on maxillary. Branchiostegal rays 4-5; gill rakers 13 below; exposed suborbitals of approximately equal width. Abdominal scutation weak, about 12 small preventral plus 17 postventral scutes; scales small. Predorsal spine present; rayed dorsal with 22 rays; adipose short, not rayed; anal count 34.

1. **Mylesinus schomburgkii** Valenciennes

Plate 1; figure 2c

Since the original description of this species is based in part on a drawing, it is impossible, at least until topotypic material is collected, to know whether the specimens described by Kner, or the one at hand, actually represent *M. schomburgkii.*

The single specimen before me, C.A.S. 20221, is 205 mm. in standard length and was collected by Dr. Carl Ternetz at Mosondó on the Maranhão, a tributary of the Upper Tocantins in the State of Goiaz, Brazil, on Oct. 2, 1923.

Depth 1.9, head 4.0 in the standard length. No teeth on maxillary. Five teeth on each side in the outer row above, gradually becoming smaller from the center toward the sides; each tooth flattened from front to rear, with small lateral lobes and a large, rounded median lobe (well figured in Cuvier and Valenciennes, 1849, pl. 644). Close behind the central teeth of the outer series of each side of the upper jaw lie two more or less molariform teeth (fig. 2c) with highly raised posterior rims; these posterior teeth are much wider than thick. Lower jaw with 8 or 9 teeth on one side in an outer series, similar in shape to the outer teeth of the upper jaw. A small, backwardly projecting, conical tooth behind the central tooth of the outer series below on each side.

Maxillary rather short and broad, truncate below, independently movable. Branchiostegal rays 4-5. Gill rakers short and stiff, 13 below. The second suborbital (the first suborbital or lacrymal is not exposed) deeper than the third; the width of the latter contained 9.3 times in the head. Lower jaw relatively long, its length from front of symphysis to articulation with skull 2.9 in head.

Scales cycloid, about 38/82/32. Pectoral rays 17; ventrals 8-8; anal 34; dorsal 22; caudal with 17 branched rays. Adipose base 7, dorsal-adipose distance 2.3 in dorsal base. Anal bilobed, commencing behind level of base of last dorsal ray, with its basal third covered with a heavy sheath of scales similar to those on body. Dorsal more or less falcate, the first rays long but not filamentous.

Predorsal spine well developed. Predorsal midline naked for a short distance ahead of predorsal spine, scaled from there to tip of supraoccipital. Twelve weak scutes before ventral bases, followed by 9 stronger, these in turn followed by 8 pairs of scutes surrounding the forward part of the anus. Intestine and anus of a wide diameter; stomach elongate U-shaped, full of plant remains.

Border of caudal, dorsal, and anal dusky; body plain golden, darker above.

TABLE 2

Ranges of counts for the species of *Utiaritichthys* and *Mylcus*. Synonyms in parentheses. Ranges of counts are not necessarily based on total number of specimens examined. The number of pectoral rays seems to have no systematic significance.

	Author	No. of specimens examined	Tooth formula	No. of gill rakers above and below	Total No. of dorsal rays	Total No. of anal rays	No. of ventral rays	No. of scutes: Pre-ventral + post-ventral	No. of scutes: Total	Scale formula
Utiaritichthys sennae-bragai	Miranda Ribeiro	4	5+2/5+1	13/14	20	36	....	9+16	25	31/86/26
	Gosline	1	5+2/5+1	x/16	22	33	8-9	10+x	....	x/100/x
Myleus micans	Lütken	2	5+2/6+1	....	27-28	36-39	8	....	52-53	35/100-115/30-33
	Eigenmann, 1915	2	....	....	26	37-38	....	....	51-54	....
	Norman	1	....	x/16	25	38	....	32+18-22	50-54	....
M. altipinnis	Valenciennes	1	....	....	24	38	8	....	....	....
M. setiger	Müller & Troschel	1(?)	5+2/5+0	....	22	36-39	9	....	39	....
	Norman	2	x+x/x+1	x/15-16	22-25	34-37	....	21-23+15-16	....	....
	Gosline	5	5+2/5+0-1	8-11/13-15	20-23	33-34	8	20-25+12-18	32-40	38-44/74-100/30-43
(doidyxodon)	Valenciennes	1	2(?)+2/x+1	....	22	35	....	....	....	....
M. knerii	Steindachner	1	x+2/5+1	....	27	34	8	....	36-37	38/70/28
M. pacu	Schomburgk	2	4-5+2/4-5+1	....	22	43	9	....	....	....
	Eig., 1912 & 1915	4	5+2/5+1	....	23-25	36-38	....	....	35	43/95-110/34
(divaricatus)	Valenciennes	1	x+2/x+1	....	23	33	....	....	....	....
(trilobatus)	Valenciennes	2	5+2/x+1	....	23	39	8	....	35	x/90/x
(unilobatus)	Valenciennes	1	x+x/5+1	....	21	36	9	18+17	35	....
M. torquatus	Kner	?	5+2/4+1	....	25	34-36	8	....	39-42	....
	Gosline	11	5+2/5+1	7-11/15-16	24-27	32-36	8	24-30+13-18	37-46	....
M. ternetzi	Norman	2	5+2/x+0	x/10	24-26	30-33	....	23-26+14-17	....	....
M. schomburgkii	Jardine	1(?)	....	....	25	39	8	....	....	....
	Eigenmann, 1915	9	....	....	25-26	34-36	....	....	33-36	....
	Gosline	1	5+2/5+1	13/15	24	35	7-8	....	34	35/80/31
(palometa)	Valenciennes		....	....	....	....	....	....	....	....
M. rhomboidalis	Cuvier	?	....	....	22-24	32-36	8-9	....	....	x/125/x
	Norman	8	....	x/14-17	24-25	35-37	....	22-28+13-15	....	....

	Author	No. of specimens examined	Tooth formula	No. of gill rakers above and below	Total No. of dorsal rays	Total No. of anal rays	No. of ventral rays	No. of scutes: Pre-ventral + post-ventral	No. of scutes: Total	Scale formula
	Gosline	2	5+2/5+1	5/14	23	35	7-8	26+15-16	41-42	....
(parma)	Günther	2	5+2/5+1	....	23-24	38	7-8	....	36	....
(discoideus)	Kner	?	5+2/5+1	....	23	34	8	....	33	....
M. latus	Schomburgk	...	....	....	22	37	8	....	....	....
	Müller & Troschel	1	5+2/5+1	....	23	34-37	9	....	38	....
	Eigenmann, 1912	21	....	....	23-24	35-36	....	....	37-41	....
	Norman	2	....	x/15	24-25	34-35	....	23-25+12-14	....	....
M. rubripinnis	Müller & Troschel	1	5+2/5+1	....	26	42	7	....	41	....
	Günther	3	....	....	26-27	38-42	7-8	....	33-36(?)	....
	Eigenmann, 1912	17	....	....	26-28	36-44	....	33-41+ 4- 8	....	x/88/x
	Norman	4	....	x/16-17	27-28	39-43	....	29-32+17-19	....	....
	Gosline	1	....	16/16	27	45	....	26+12	38	....
M. asterias	Müller & Troschel	1(?)	5+2/5+1	....	29-31	40	8	....	43-45	....
	Günther	4	....	....	29-31	39-40	8	....	....	....
	Eigenmann, 1912	2	....	....	27	35-39	....	....	48-52	x/87-89/x
	Norman	10	....	x/14-16	27-32	37-41	....	28+10	38	....
(ellipticus)	Günther	2	5+2/5+1	....	27-29	39	7	....	41-51	....
(schulzei)	Ahl	1	....	....	29	39	....	....	46	....
M. maculatus	A. Campos	1	x+x/x+1	....	28	36	....	....	33	....
	Gosline	6	5+2/5+1	6-14/13-17	(21) 24-26	35-38	6-7	30-33+12-20	43-51	....
(lobatus)	Valenciennes	3	....	....	23	33	....	....	....	....
M. gurupyensis	Steindachner	2	x+x/3(?)+1	....	28	32-34	6	24+12-13	36-37	42/90/42
	Gosline	7	....	....	25-27	32-38	6-7	24-31+16-19	41-48	....
M. tieté	Eig. & Norris	1	x+x/6+1	....	27	37	....	....	46	....
	Eig. & Kennedy	1	....	....	27	35	....	....	44	x/80/x
(levis)	Eig. & McAtee	1	5+2/5+1	....	27	36	....	....	45	x/112/x
	Eigenmann, 1915	3	....	....	27-31	35-36	....	....	40-53	....
	Norman	3	....	x/14-16	27-28	33-36	....	26-29+16-19	....	....

IV. **Utiaritichthys** A. de Miranda Ribeiro

Utiaritichthys A. DE MIRANDA RIBEIRO, 1937, p. 58 (genotype by monotypy *Utiaritichthys sennae-bragai).*

Utiaritichlys A. DE MIRANDA RIBEIRO, 1937, p. 58 (misprint for *Utiaritichthys).*

The single known species of this genus, *U. sennae-bragai,* was originally described from four specimens, the largest 380 mm., from above the Utiarity Falls on the Rio Papagaio, in the upper Rio Tapajós basin, State of Mato Grosso, Brazil.

Teeth 5+2/5+1; no teeth on maxillary. Branchiostegal rays 4-4; gill rakers 15 below; exposed suborbitals of approximately equal width. Abdominal scutation weak, about 9-10 preventral and 16 postventral scutes; scales small. Predorsal spine present; rayed dorsal with 20-22 rays; adipose short, not rayed; anal count 33-36.

1. **Utiaritichthys sennae-bragai** A. de Miranda Ribeiro

Table 2, plate 2

A specimen at hand, C.A.S. 20222, 168 mm. in standard length, collected in the Rio Tocantins at Marabá, State of Pará, Brazil, April 24, 1924, agrees well with Miranda Ribeiro's description, even though his specimens were taken in Mato Grosso. In general characteristics, this specimen resembles the genus *Myleus,* to which it appears closely related, apparently differing from that genus only in having the scutation little developed forward of the ventrals. The front teeth of the outer row above are somewhat incisiform, but taper to a median point; they are slightly separated from the teeth of the second row, which have the rims more highly raised than is usual in *Myleus.*

The conical teeth in the lower jaw are very small.

V. **Myleus** Müller and Troschel

Table 2

Myleus as here dealt with differs rather widely from Norman's (1929) conception of the genus. In fact, since 1845, when Müller and Troschel proposed the genus, no two authors have agreed on the generic classification of the group to which it belongs. *Myleus,* as I understand it, comprises all those species of serrasalmine fishes with 20 or more dorsal rays and with at least 2/3 of the abdomen with scutes along the midline. So constituted it includes *Myleus, Myloplus,* and *Paramyloplus* of Norman. These three genera Norman separated as follows (1929, p. 782)

"Conical mandibulary teeth present . . .

Anterior teeth of outer series of praemaxillary compressed, incisor-like, in contact with those of inner series .... 8. *Myleus*

Anterior teeth of outer series of praemaxillary with an oblique cutting edge, not greatly compressed, generally more or less separated from those of inner series .... 9. *Myloplus*

No conical mandibulary teeth .... 10. *Paramyloplus*"

As to the presence of conical mandibulary teeth in *Myleus* and *Myloplus*, the type of *Myleus setiger* is described as lacking them. Furthermore, of three Carnegie Museum specimens which Eigenmann has identified as *Myleus pacu*, C.M. No. 5749 has a pair of conical teeth, No. 5750 has a single one, and No. 5751 has none.

Norman's wording of the distinction between *Myloplus* and *Myleus* is not entirely clear to me. Nevertheless, that all degrees of intergradation between the two tooth types described by him occur may be verified by a simple examination of Eigenmann's tooth drawings (1915, pp. 269 and 270, figs. 12-14). I have seen the tooth sets from which the drawings were made, and they are as shown. Still another type of dentition found in this genus is shown in figure 6, and further discussion of the subject is given below.

Eigenmann (1915, p. 262) has differentiated *Myloplus* from *Myleus* chiefly on the presence of prolonged, filiform dorsal rays in the adult males of *Myleus* and their absence in *Myloplus*. But it appears that some, perhaps all, adult males of *Myloplus* have prolonged, filiform dorsal rays.

No other characters have been used for separating *Myleus, Myloplus,* and *Paramyloplus,* and I can find none.

Specific classification within the genus is likewise difficult. The problems presented are partly zoological, partly nomenclatorial. Of the 27 described species which belong to the genus, 19 were described before 1865. The type of only *M. levis* is in this country. Many of the older descriptions were based on incomplete or stuffed specimens. Furthermore, considerable confusion has arisen in the literature because of the sexual differentiation within the genus. Females have a falcate anal, whereas in adult males the anal is bilobed. Furthermore, adult males of at least some species have filamentous dorsal rays. Thus the males and females of the same species have often been described under different names. On the other hand, Kner (1859), who realized that there was sexual differentiation, went too far in synonymizing names, and in several places combined under one name males and females of two different species; I find nothing to support Kner's contention that there is sexual differentiation in dentition.

Zoologically, the species present several further problems. Most of the forms grow to large size, and the measurement ratios change considerably during growth. Of meristic characters, the scale count is extremely unreliable because the scales are small and in rather irregular rows. Fin ray and scute counts are valuable, but show considerable variation; the variability within any species is partly individual and partly geographical, and there are insufficient specimens available in museums to disentangle these two sources of variation or to determine their limits.

The species of the major part of the genus *Myleus* have never been revised. Under the circumstances, the synopsis of species presented below cannot hope to give more than direction to future work. So far as known, specimens of all ten or so species represented in American museums have been examined. These specimens have been used as a yardstick for evaluating the literature.

There seem to be three main categories of tooth types represented in this genus:

I. The front three teeth of the outer row above on each side are considerably compressed from front to back (fig. 6b) and expanded laterally so as to become somewhat spoon-shaped (fig. 6a); these teeth are in contact or slightly overlap one another at the sides. The molar teeth of the second row above are appressed against the inner bases of the first two of the teeth of the row in front and are considerably wider than deep. The teeth of the outer row of the lower jaw form approximately a semicircle. The conical teeth of the second row below are very small.

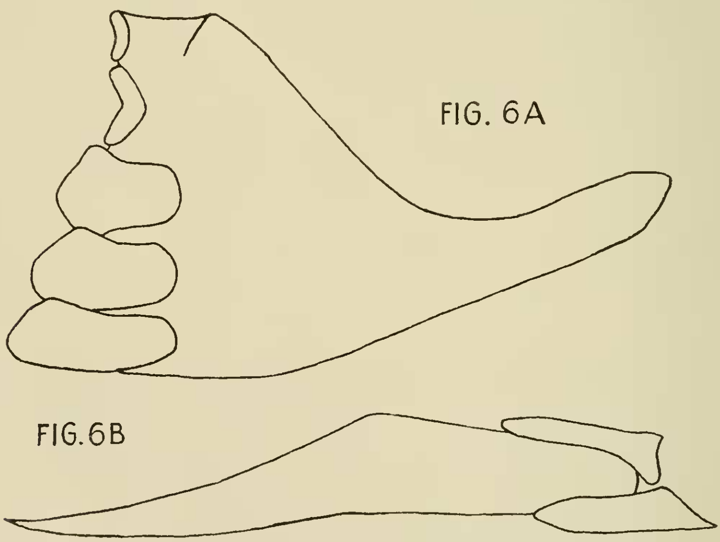

Figure 6. Right premaxillary of *Myleus setiger* from the Rio Tocantins. a. View about half way between front and lateral; b. Sagittal view.

II. This is the tooth type illustrated by Eigenmann, 1915 (p. 270, fig. 13). The chief differences between this and type I are that the first two teeth on each side in the outer row above are less flattened from front to rear and are separated from one another, and the molariform teeth of the second row are little or not appressed against the teeth of the outer row.

III. Eigenmann's figure 12 (1915, p. 269) illustrates this type. The front teeth of the outer row are more or less conical. The molar teeth behind are as deep as, or deeper than, broad. The front four teeth below form an almost straight line across the front of the lower jaw. Conical teeth behind are usually present, sometimes absent. Most of the species of the genus have dentition of type III, with the molar teeth often farther removed from the front teeth of the upper jaw than shown in Eigenmann's figure 12.

Eigenmann infers that type III may change to type II with increase in age (1915, figs. 12 and 13). He may be correct in this, though I know of no evidence for it. On the other hand, *M. setiger,* which I believe belongs to type I, is generally synonymized with *M. pacu,* which has type II dentition. Thus the three tooth types described above, though they may be good as specific characters, grade into one another and are difficult to use. Furthermore, no supplementary characters which may be correlated with the three tooth types were found. Nevertheless, I suggest, at least as a working hypothesis, that Eigenmann's figures 12 and 13 of *Myleus pacu* actually represent two different species and that *Myleus setiger* is a third species with tooth type I. A graded size series of *Myleus pacu* might quickly settle this question, but there is no such series.

Teeth 5+2/5—6+0—1; no teeth on maxillary. Branchiostegal rays 4-4; gill rakers 6—14/13—17; first exposed suborbital somewhat deeper than the others. Abdominal scutes moderately developed, 33-54; scales small. Predorsal spine present; rayed dorsal with 21-31 rays; adipose short, not rayed; anal count 30-44.

The distribution of the genus *Myleus* is from the Guianas to La Plata and from the eastern base of the Andes to the Rio São Francisco. The Paraguayan form seems to be slightly different from its Amazonian relatives, and only one species, *M. setiger,* is tentatively considered to inhabit both the Amazon basin and Guiana. As with other groups of fishes, the representation of this genus in the Orinoco is unknown.

To the synonymy of *Myleus* add *Tomète* Amaral Campos, 1944, p. 211 (emendation of *Tometes* Valenciennes, in Cuvier and Valenciennes, 1849, p. 225; *Tomète,* attributed by Amaral Campos to Cuvier and Valenciennes, was used by Valenciennes only as a French common name for a fish of the genus *Tometes).*

PRELIMINARY KEY TO THE SPECIES OF MYLEUS

1. Scutes on the ventral midline 50 or more; teeth on the outer row of the lower jaw 10 to 12. Species of the São Francisco basin 2

— Scutes usually fewer than 50; teeth of the outer row of the lower jaw never more than 10. Species not found in the Rio São Francisco basin 3

2.(1) Depth of body $1\frac{1}{2}$ in the length; posterior dorsal rays not longer than those of middle of fin (Norman) .... 1. *M. micans*

— Depth of body twice in the length; posterior dorsal rays rather higher than those in middle of fin (Norman) .... 2. *M. altipinnis*

3.(1) Front 6 teeth of outer row above incisiform, more or less spatulate, the first and second teeth from the front on either side in contact or slightly overlapping one another (fig. 6a); molar teeth of inner row appressed against bases of teeth of outer row (fig. 6b). Dorsal rays of adult males prolonged as filaments 4

— Front 6 teeth of outer row above more or less conical, well separated from one another; molar teeth of inner row of upper jaw never flattened against the teeth of the outer row 5

4.(3) Dorsal rays 22-25. British Guiana and Amazon basin .... 3. *M. setiger*

— Dorsal rays 27. French and Dutch Guiana .... 4. *M. knerii*

5.(3) The two teeth of the inner row of the upper jaw adjacent to the teeth of the outer row, the individual teeth broader (from side to side) than deep (from front to back). British and French Guiana .... 5. *M. pacu*

— The two teeth of the inner row of the upper jaw separated from the outer row, the individual teeth deeper than broad 6

6.(5) Caudal with a distinctly delimited black margin. Dorsal rays 24-27; dorsal origin nearer end of vertebral column than tip of snout. Central Amazon basin .... 6. *M. torquatus*

— Caudal sometimes with a dusky border, but never with a distinctly delimited marginal black band 7

7.(6) Species with a single, large, well-defined black blotch on side 8

— Species without a single well-defined dark blotch on sides 9

8.(7) Black blotch extending from anal fin forward onto body, not reaching as high as lateral line; no conical mandibular teeth. French Guiana .... 7. *M. ternetzi*

— Black blotch extending downwards and backwards across lateral line from below dorsal to above depressed ventral; conical teeth present. Amazon basin .... 8. *M. schomburgkii*

9.(7) Dorsal relatively short and high, the height of its anterior rays longer than the dorsal base; distance from base of last dorsal ray to end of vertebral column about equal to the dorsal base. Dorsal origin considerably nearer snout than end of vertebral column, its rays 22-25; caudal peduncle appreciably deeper than long; adipose fin relatively large, its base contained about 5 times in the dorsal base 10

— Dorsal relatively long and low, the anterior rays (exclusive of the dorsal filaments of adult males) less than length of dorsal base; distance from base of last dorsal ray to end of vertebral column less than length of dorsal base 11

10.(9) Distal part of the anterior anal rays black (Norman). Amazon basin........ ....9. *M. rhomboidalis*

— Anterior anal rays yellowish white (Norman). Guiana..........10. *M. latus*

11.(9) Middorsal profile of head concave over the eyes; dorsal somewhat falcate, the last rays about 2.7-3.0 in the length of the second which is nearly equal to the head length; anal rays 36-45. Dorsal adipose distance contained 3½-4½ in the dorsal base. British Guiana..........11. *M. rubripinnis*

— Middorsal profile of head flattish or evenly convex over the eyes; except in adult males with dorsal filaments, the dorsal fin has a rounded border and the length of the last dorsal rays is contained about 2.1-2.2 in the length of the second, which is far shorter than the head; anal rays 32-41..........12

12.(11) Interorbital width about 2 in head..........13

— Interorbital width contained fewer than 2 times in the head. Paraguay river system..........15. *M. tieté*

13.(12) Ventral rays 8 (7?); sides with small orange spots; dorsal rays 27-31, not filamentous in adult males. British Guiana..........12. *M. asterias*

— Ventral rays 7 or 6; sides sometimes with irregular dark blotches, but not with bright orange spots; dorsal rays (21) 24-28..........14

14.(13) Dorsal rays filamentous in the adult male. Amazon basin....13. *M. maculatus*

— Dorsal rays without filaments in the adult male. Amazon basin.......... ....14. *M. gurupyensis*

1. **Myleus micans** (Lütken)

Myletes (Tometes) micans LÜTKEN, 1874, p. 137 (Rio das Velhas and its tributary, the Rio Taquoaraçú, in the vicinity of Lagoa Santa, State of Minas Gerais, Brazil); LÜTKEN, 1875, p. 241, figs. on p. 243 (on the types).

Myloplus micans, EIGENMANN, 1915, p. 270, fig. 14 (Cidade do Barra, at the junction of the Rio Grande and the Rio São Francisco; and Santa Rita on the Rio Preto, a tributary of the Rio Grande, State of Minas Gerais, Brazil).

Myleus micans, NORMAN, 1929, p. 822 (Rio das Velhas, State of Minas Gerais, Brazil).

This species (and the following?) possesses two characters which appear to be primitive for the genus. One is the large number of abdominal scutes, totaling 50-54, and, at least occasionally, the presence of more than 5 teeth on one side of the lower jaw in the outer row. Also, the front teeth of the lower jaw have broader lateral lobes than is usual in the genus; the teeth of the upper jaw conform rather closely to type II described above. The general appearance of the head of the fish is distinctively sheep-like. This species and *M. altipinnis* are the only representatives of *Myleus* in the São Francisco basin.

2. **Myleus altipinnis** (Valenciennes)

Tometes altipinnis VALENCIENNES, in Cuvier and Valenciennes, 1849, p. 230, pl. 643 (Rio São Francisco, Brazil).

Myletes altipinnis, GÜNTHER, p. 377 (Rio Cipo, a tributary of the Rio das Velhas, State of Minas Gerais, Brazil).

Myleus altipinnis, NORMAN, 1929, p. 823 (on Günther's specimen).

This form is generally considered to be very close to, if not identical with, the preceding species. The characters used in the key to differentiate *M. altipinnis* from *M. micans* are those given by Norman (1929, p. 821).

3. **Myleus setiger** Müller and Troschel

Figure 6

Myleus setiger MÜLLER AND TROSCHEL, 1845, pp. 24 and 39, pl. 11 (Essequibo River, British Guiana; Surinam); Norman, 1929, p. 821 (loc. ?).

Myletes doidyxodon VALENCIENNES, in Cuvier and Valenciennes, 1849, p. 222 (Amazon); Castelnau, 1855, p. 67, pl. 34, fig. 1 (Amazon).

Myletes setiger, KNER, 1859, in part, p. 27, pl. 2, figs. 6 and 6a (loc. ?).

This species is generally considered to be the young of *M. pacu*, which may be true. Provisionally I prefer to identify Müller and Troschel's species with some Rio Tocantins specimens which have the dentition shown in figure 6. It may prove, however, that these specimens are not *M. setiger*, in which case they will have to go by Valenciennes' name, *M. doidyxodon*.

Myleus setiger, as the species is here interpreted, differs from *M. pacu* in the dentition, in having the dorsal in the females more falcate, and in the extremely long dorsal filaments (Kner, 1859, pl. 2, fig. 6) in males as small as 150 mm. The largest specimen of this species known is 12 inches long. The range is tentatively given as the Amazons and Guiana.

Conical teeth in the lower jaw seem to be small or absent depending upon the specimen.

4. **Myleus knerii** (Steindachner)

Myletes knerii STEINDACHNER, 1881, p. 127, pl. 7, fig. 2 (Maroni River, Guiana).

This species is very close to *M. setiger*, differing in the higher dorsal ray count.

5. **Myleus pacu** (Schomburgk)

Myletes pacu SCHOMBURGK, 1841, p. 236, pls. 20 and 21 (British Guiana).

?*Myletes divaricatus* VALENCIENNES, in Cuvier and Valenciennes, 1849, p. 215 (Essequibo River, British Guiana).

Tometes trilobatus VALENCIENNES, in Cuvier and Valenciennes, 1849, p. 226 (Cayenne).

Tometes unilobatus VALENCIENNES, in Cuvier and Valenciennes, 1849, p. 228 (Cayenne).

Myleus pacu, EIGENMANN, 1912, p. 393, pl. 59, figs. 5 and 6 (falls of the Mazaruni River, British Guiana); EIGENMANN, 1915, fig. 13 on p. 270 only (dentition of one of the British Guiana specimens).

The front teeth of the outer row of the upper jaw of this species are well separated from one another (Eigenmann, 1915, fig. 13), as contrasted with *M. setiger*. In large specimens the anterior midventral scutes are buried in flesh. The front dorsal rays in the female are not much longer than the posterior rays, and the dorsal fin outline is rounded rather than falcate; the anterior dorsal rays of the adult male reported on by Eigenmann (1912) have short free filaments. Only very large specimens from British Guiana (those of Schomburgk and Eigenmann, 1912) are positively identifiable as this species.

The name *Myletes pacu* Schomburgk is not preoccupied by *Myletes paco* (sic) Humboldt. *Myletes divaricatus* is questionably identified as this species because the teeth of the outer row of the upper jaw are said to be "assez épaisses; le bord est triangulaire et pointu." In other characters *M. divaricatus* seems to be closer to *M. setiger;* however, it has a lower number of anal rays than either *M. pacu* or *M. setiger*. Another possibility is that *M. divaricatus* is the adult male of *M. rhomboidalis*.

6. **Myleus torquatus** (Kner)

Myletes torquatus KNER, 1859, p. 24, pl. 1, fig. 4 (Rio Branco, State of Amazonas, Brazil).

The most striking feature of this species as described by Kner is the black vertical band on the sides. However, I have here identified as this species one specimen 97 mm. long from the vicinity of Santarem, State of Pará, and ten specimens 94-104 mm. from Maués, on the southern channel from the Madeira into the Amazon, State of Amazonas, Brazil (M.C.Z. No. 19104); in the Santarem specimen the blotch on the side is completely lacking and in the Maués material it is faint. All agree with *M. torquatus* in having a black caudal margin, and in meristic characters (see table 2).

7. **Myleus ternetzi** (Norman)

Paramyloplus ternetzi NORMAN, 1929, p. 828, pl. 1 (Maparú Rapids, Approuague River, French Guiana).

This species is distinctive because of the large black blotch which extends from the anal forwards on to the body but does not reach the lateral line. Conical teeth in the lower jaw absent. About 10 gill rakers below.

This species is known only from a single specimen.

8. **Myleus schomburgkii** (Jardine)

Tetragonopterus schomburgkii Jardine, in Schomburgk, 1841, p. 243, pl. 22 (Rio Negro).

?*Myletes palometa* Valenciennes, in Cuvier and Valenciennes, 1849, p. 214 (Orinoco at the mouth of the Rio Jao).

Myletes divaricatus (*non* Valenciennes), Kner, 1859, p. 23 (Rio Branco).

Myletes schomburgkii, Steindachner, 1876, p. 86 (on Kner's specimen?).

Myloplus schomburgkii, Eigenmann, 1915, p. 271, pls. 56 and 57 (Manaos and Santarem on the Amazon); Norman, 1929, p. 824 (Rio Madeira).

9. **Myleus rhomboidalis** (Cuvier)

Myletes rhomboidalis Cuvier, 1818, p. 449, pl. 22, fig. 3 (Amazon); Cuvier and Valenciennes, 1849, p. 210 (Amazon).

Myletes discoideus Kner, 1859, p. 30 (Bananeira; Rio Branco; Mato Grosso).

Myletes parma Günther, 1864, p. 374 (Rio Capin, south of Belém, State of Pará, Brazil).

Myloplus rhomboidalis, Eigenmann, 1915, p. 271 (Manaos; Rio Madeira); Norman, 1929, p. 827 (Amazon).

This species and *M. latus* seem to make up a rather easily distinguishable species complex. A specimen of *M. rhomboidalis* 120 mm. long from the Santarem market has the dorsal, anal, and caudal with obscure dusky margins; there is a narrow naked area extending along the dorsal midline from the supraoccipital to the predorsal scute. The head is short and broad, and the eye large.

10. **Myleus latus** (Schomburgk)

Tetragonopterus latus Schomburgk, 1841, p. 241 (Guiana).

Myletes latus, Müller and Troschel, 1845, pp. 24 and 37 (Essequibo River, British Guiana).

Myloplus rhomboidalis (*non* Cuvier), Eigenmann, 1912, p. 392, pl. 58, figs. 1-4 (British Guiana).

Myloplus latus, Norman, 1929, p. 827 (Guiana).

This species is closely related to, if not identical with, *M. rhomboidalis*.

11. **Myleus rubripinnis** (Müller and Troschel)

Myletes rubripinnis Müller and Troschel, 1845, pp. 23 and 38, pl. 9, fig. 3 (Essequibo River, British Guiana).

Myloplus rubripinnis, Eigenmann, 1912, p. 391, pl. 57, fig. 2 (Crab Falls, Rockstone, Bartica, Malali, and Tumatumari, all in British Guiana).

The species complex including *M. asterias* and *M. rubripinnis* is extremely confusing. Two species of the group, those just named, occur in

British Guiana; at least two are in the Amazon; and one is in the Paraguay system. The species of any one area can apparently be distinguished, but the criteria so used break down when applied to other areas. The treatment and synonymies of the complex, particularly of the Amazonian forms, here presented are entirely provisional.

12. **Myleus asterias** (Müller and Troschel)

Myletes asterias Müller and Troschel, 1845, pp. 24 and 36, pl. 10, figs. 2 and 2a (Essequibo River, British Guiana); Günther, 1864, p. 373 (Essequibo River, British Guiana).

Myletes ellipticus Günther, 1864, p. 375 (Essequibo River, British Guiana).

Myloplus asterias, Eigenmann, 1912, p. 392, pl. 57, fig. 3 (Malali, British Guiana); Norman, 1929, p. 824 (British Guiana).

?*Myloplus schulzei* Ahl, 1938, p. 191 (South America).

This species is most readily recognized by the bright orange spots on the sides. Unfortunately, according to literature, these are not always present. The adult males of *M. asterias* seem never to develop filamentous dorsal rays.

13. **Myleus maculatus** (Amaral Campos)

?*Myletes lobatus* Valenciennes, in Cuvier and Valenciennes, 1849, p. 212 (Amazon).

Myleus pacu, Eigenmann (in part, *non* Schomburgk), 1915, p. 269, fig. 12 (Manaos, State of Amazonas, Brazil).

Tomète maculatus Amaral Campos, 1944, p. 211, fig. (Rio Amazonas).

I have examined specimens of at least two forms of the *M. asterias-rubripinnis* group from the Amazon region. One is represented by six specimens, 174 to 208 mm., from Maués, on the southern connective between the Rio Madeira and the Amazon (M.C.Z. Nos. 19229 and 19310). These specimens differ from the Tocantins form of the complex considered below in having the dorsal rays of the adult males prolonged; the dorsal-adipose distance contained 2.2-4.5 times in the dorsal base; the depth of the caudal peduncle greater than its length to the end of the vertebral column; the dorsal origin nearer the tip of snout than the end of the vertebral column; the dorsal base shorter than the anal base; the middorsal line scaleless between supraoccipital and dorsal; the greatest width of opercle 2½-3 times in its greatest depth; the teeth broader.

The specimens described above also differ from the description of *Tomète maculatus* in a number of ways. The latter species seems to have a longer dorsal, a shorter dorsal-adipose interspace, and blotches on the sides. However, Eigenmann's specimens of "*M. pacu*" from Manaos are more or less intermediate between the Maués specimens and the description of

T. maculatus. The dorsal counts in the three Manaos specimens are 25, 27, 28; the dorsal-adipose distance 4.0, 4.0, 5.4; and one of the specimens is blotched, the others plain.

Consequently, the identification of the specimens from Maués with *M. maculatus* is chosen as a preferable alternative to the description of a dubious new species in an already confused group.

14. **Myleus gurupyensis** Steindachner

Myleus gurupyensis STEINDACHNER, 1911, p. 342 (Rio Gurupí near Chatão, between the States of Maranhão and Pará, Brazil).

Myloplus arnoldi AHL, 1936, p. 26 (Amazonas).

I provisionally identify as this species six specimens from the Rio Tocantins, 79-180 mm. The largest male is 124 mm. long and is perhaps not big enough to develop dorsal filaments. Other characters in which these specimens differ from the Maués form, identified above as *M. maculatus*, are dorsal-adipose interspace contained 4.3-5.7 in dorsal base; depth of caudal peduncle less than its length to end of vertebral column; dorsal origin about equidistant from end of vertebral column and posterior nostril; dorsal base slightly longer than anal base; much of the middorsal line scaled between the supraoccipital and the predorsal scute; greatest width of opercle 3½ in its greatest depth; teeth narrow and thicker.

The Rio Tocantins specimens do not disagree greatly with Steindachner's description of *M. gurupyensis*, but the Amazon forms of this species complex are so confusing that any identification at all is rather tenuous. The relationship between this species and *M. asterias* seems to be rather close.

Myloplus arnoldi Ahl was described from a juvenile specimen 58 mm. in total length.

15. **Myleus tieté** (Eigenmann and Norris)

Myletes tieté EIGENMANN AND NORRIS, 1900, p. 359 (Rio Piracicaba, tributary to Rio Paraná, Brazil).

Myleus tiete, EIGENMANN AND KENNEDY, 1903, p. 529 (Rio Piracicaba).

Myleus levis, EIGENMANN AND MCATEE, in Eigenmann, McAtee, and Ward, 1907, p. 142, pl. 42, fig. 2 (Bahia Negra on the Río Paraguay, Paraguay).

Myloplus levis, EIGENMANN, 1915, p. 271 (Río Paraguay basin); NORMAN, 1929, p. 825 (Río Paraguay).

This form seems to be the Paraguay basin representative of the *M. asterias-rubripinnis* complex. It appears to be separable from related forms chiefly on the basis of the broader interorbital. In Eigenmann and McAtee's original description of *M. levis* no comparison is given between that species and *M. tieté*. In fact, through an oversight of one sort or another, *M. tieté* is not included in Eigenmann, McAtee, and Ward's list of fishes from the Paraguay basin (1907, p. 154).

VI. **Acnodon** Eigenmann

The generic name *Acnodon* is based on the misimpression that the type species, *A. oligacanthus,* from Guiana, had no predorsal spine. The best description and figure of the genus and hitherto single known species are to be found in Steindachner (1917, p. 54, pl. 6, fig. 4). A second species of *Acnodon* is described below.

Teeth 5+2/5+1; no teeth on maxillary. Branchiostegal rays 4-4; gill rakers few, 9-11/6-10; first exposed suborbital deeper than the others. Abdominal scutation absent before ventrals; 6-8 scutes between ventral origins and anal; scales small. Predorsal spine present; rayed dorsal with 15-19 rays; adipose of moderate size, not rayed; anal count 33-36. (Diagnosis based primarily on *Acnodon normani,* described below.)

Acnodon normani Gosline, new species

Table 3; plate 3; figure 5b

Holotype: C.A.S. 20223, 127 mm. in standard length, collected by Dr. Carl Ternetz, January 25, 1924, in Rio Santa Teresa, a western tributary of the upper Rio Tocantins, State of Goiaz, Brazil.

Paratypes: C.A.S. 20224 and U.M.M.Z. 144344, 17 specimens, 68-115 mm. in standard length, with the same collection data as the holotype.

Also examined: C.U. No. 3272, collected by C. F. Hartt (no locality or collection date recorded).

Five teeth on each side in the outer row above, the first three conical, somewhat hooked, the lateral two more or less molariform. Second row in the upper jaw widely separated from the front row, consisting of two more or less triangular molars on each side, each tooth with one apex of the triangle pointing posteriorly, the other two laterally; crowns with the anterior rim low, the postero-lateral rims somewhat raised. No teeth on maxillary. Lower jaw with 5 teeth on each side in the outer row, the front two forming a fairly straight line across the front of the jaw, the individual teeth fitting in between the molars of the upper jaw when the mouth is shut. A fleshy tab behind the two central teeth of the lower jaw, but no conical teeth.

Lower jaw very short, undershot, resembling the jaw of *Creagrutus.* Maxillary freely movable, partly sliding under the suborbital bones, with a

TABLE 3

Counts and measurements of the holotype and eleven paratypes of *Acnodon normani*. All measurements, other than standard length, are given in thousandths of standard length.

	Holotype	Paratypes											Range	Average
Standard length (mm.)	127	115	108	105	100	85	80	78	74	74	70	68	68-127	90
Total number of gill rakers	22	18	20	20	18	19	18	17	15	18	22	19	15- 22	19
Total number of dorsal rays	18	17	17	19	15	18	18	18	18	18	19	17	15- 19	18
Total number of anal rays	35	35	33	35	36	33	35	36	35	35	35	35	33- 36	35
Number of pectoral rays	17	15	16	18	16	16	15	17	18	17	16	14	14- 18	16
Number of ventral rays	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Total number of mid-ventral scutes	6	7	7	8	8	7	7	8	6	6	7	7	6- 8	7
Depth	536	548	547	553	560	565	537	513	527	527	515	573	513-573	542
Head	294	287	293	287	293	296	296	296	308	296	289	300	287-308	294
Snout	99	102	103	101	104	105	102	101	110	111	101	101	99-111	103
Eye	87	92	92	93	94	96	101	101	107	104	108	104	87-108	98
Interorbital	89	90	84	88	90	89	89	89	91	90	86	87	84- 91	88
Length of maxillary	64	61	72	67	77	79	70	67	77	68	59	60	59- 79	68
Length of lower jaw	79	87	82	82	87	85	93	91	96	99	87	75	75- 99	87
Post-orbital part of head	120	114	121	116	109	125	121	120	120	112	119	115	109-125	118
Length of occipital process	98	102	100	108	106	107	104	105	93	99	99	100	93-108	102
Distance from base of occipital process to origin of rayed dorsal	324	329	318	336	325	345	320	322	312	306	291	307	291-345	320
Distance from tip of snout to origin of rayed dorsal	557	558	562	570	568	575	562	559	568	556	543	547	543-575	560
Distance from origin of rayed dorsal to end of vertebral column	590	576	572	612	592	588	620	606	586	579	601	554	554-620	590
Length of longest dorsal ray	385	392	368	392	....	598	611	....	487	....	417	....	368-611*	456*
Length of last dorsal ray	95	98	91	94	109	99	101	101	108	99	100	106	91-109	100
Length of dorsal base	212	228	232	244	203	229	229	227	228	228	214	216	203-244	224
Distance from base of last dorsal ray to origin of adipose	160	176	177	174	176	177	180	181	180	169	170	160	160-181	173
Length of adipose base	80	69	78	78	92	74	77	91	69	78	87	74	69- 92	77
Depth of caudal peduncle	87	90	96	84	89	93	101	82	91	90	86	84	82-101	89
Length of caudal peduncle	109	109	114	99	103	104	101	102	105	99	96	112	96-114	104
Length of anal base	277	273	286	282	274	273	270	258	257	275	261	259	257-286	270
Length of longest anal ray	261	236	286	270	301	292	270	272	....	285	281	259	236-301*	274*

* Based on fewer than twelve specimens; see individual figures.

fleshy flap on its lower tip. A fringed membrane between the maxillary and the lower jaw. Lower lip thick, its upper surface, against which the outer teeth of the upper jaw bite, furry.

First exposed suborbital the largest of the series.

Gill rakers short and simple, those of the upper arch thin and not widely spaced; posterior 4 or 5 rakers of the lower arch relatively gross and widely spaced; anterior rakers of the lower arch more or less rudimentary, easily missed in counting.

Scales small; about 135 transverse rows above the lateral line in the holotype, 115-125 in four paratypes; 46 between dorsal origin and lateral line, 44-52 in four paratypes; 30 between lateral line and ventral insertion, 29-31 in four paratypes.

Supraoccipital process short. Predorsal spine strong. Outline of dorsal fin falcate; 3rd and 4th rays prolonged, in one specimen over half the standard length of the fish. Adipose fin fairly large, characteristically shaped (see plate), arising from a middorsal keel of flesh. Pectorals and ventrals long for the subfamily, the latter with basal scales which are about one-fourth the length of the fins. Ventral surface before pelvic fins somewhat flattened, covered with ordinary body scales. Midventral scutes behind ventral insertion strong, 5 to 7 simple plus 1 pair at front of anus; no scutes between anus and anal. Anal falcate anteriorly, no second lobe developed in specimens at hand, with a narrow basal sheath of scales.

Sides silvery, with vertical bluish stripes extending downward from the back nearly to lateral line (not shown in plate). Dorsal interradial membranes dusky. Caudal with a dusky border.

Acnodon normani differs at once from *A. oligacanthus* in the sharper snout and the more undershot jaw. In *A. oligacanthus* the molariform teeth of the inner row of the upper jaw are said to be just behind the teeth of the outer row; in *A. normani* the two rows of premaxillary teeth are the most widely separated of any serrasalmine known.

Named for the late John Roxbrough Norman, as partial recognition of his excellent work on the Serrasalminae as well as in other groups.

VII. **Metynnis** Cope

The generic synonymy of this genus is that given by Norman (1929, p. 815).

Metynnis may be at once distinguished from other genera of Serrasalminae by the long, low adipose fin. In this character the genus seems to represent a specialized offshoot of the serrasalmine stock, and is without close relatives.

The species of *Metynnis* are not readily separable from one another on the basis of superficial characters, at least in museum specimens. All have much the same form, counts, and markings. Like other serrasalmines, most of the species seem to have spotting in the juveniles, which is lost in the adults. On the other hand, in some of the largest specimens of *M. maculatus* the dorsal interradial membranes are spotted, while in smaller specimens the dorsal is plain. Though the spotting of the sides and of the dorsal is correlated in part with growth, considerable individual variation is also shown.

The half grown, as indicated by some specimens at least, have the anterior rays of the dorsal more elongate and the depth somewhat greater than in either the young or the adults.

Sexual differentiation appears to be slight, though the males do have the anal outline slightly lobate in front. Sexually mature adults of *M. maculatus* were not found which were less than about 120 mm. in length. The largest specimen of this genus I have seen is 145 mm. in standard length.

There is one previous revision of *Metynnis* (Ahl, 1924, pp. 15-31). In this work Ahl recorded 18 species of which 9 were described as new. There are certain *a priori* grounds for suspicion concerning the value of Ahl's revision. In the first place Ahl seems to have examined only 36 specimens. Second, though he described nine new species, he identified material with only three of the nine previously known species, and one of these three is a form he himself had described earlier in an aquarium journal. Three of Ahl's new species were based on aquarium specimens without definite original locality, and one of these, *M. seitzi,* was based on a single fish which is ''sehr beschädigt'' and has the eye and the adipose fin ''abgefressen.'' Finally it appears that the only characters which Ahl gave to differentiate his new species, those cited in his key, are based on trivialities or abnormalities. Nevertheless, to check this last point, specimens of *Metynnis* in the Museum of Comparative Zoology and in the Carnegie Museum, as well as those borrowed from the California Academy of Sciences and those in the University of Michigan Museum of Zoology, were examined. On the basis of the 100 or so specimens available I have been able to recognize the six species dealt with below; of these six, four are so closely related as to make specific differentiation somewhat doubtful.

The species are not illustrated because they look too much alike to make figures of each worth while. Furthermore, all the species here recognized have been adequately figured before.

Teeth 5+2/4+1; no teeth on maxillary. Gill rakers 7-29/12-31; branchiostegals 4-4; first exposed suborbital somewhat deeper than the others. Abdominal scutes 27-41; scales small. Predorsal spine present, often dentate on its upper surface; dorsal rays 15-20; adipose long and low; anal 36-46.

The range of *Metynnis* is from the Orinoco to La Plata. The genus is apparently absent in the Magdalena drainage and in Eastern Brazil from the São Francisco southwards.

KEY TO THE SPECIES OF METYNNIS

1. Total number of gill rakers about 60, the longest nearly equal to the diameter of the eye............1. *M. luna*

— Total number of gill rakers fewer than 40, the longest less than one-half the diameter of the eye............ 2

2.(1) Occipital process long, contained 2.4 or fewer times in the distance from its base to the origin of the dorsal; adipose fin particularly long and low, its distance from the base of the last dorsal ray contained 1.5 or more times in adipose base............2. *M. hypsauchen*

— Occipital process short, contained 2.6 or more times in the distance from its base to the origin of the dorsal; adipose fin relatively short and high, its distance from the base of the last dorsal ray usually contained about 1.2 times in adipose base, though as much as 1.6 in some individuals............ 3

3.(2) Ventral scutes greatly developed, the distance between the bottom of the ventral base and the tip of the scute below equal to more than one-half an eye diameter............3. *M. mola*

— Ventral scutes comparatively little developed, the distance from the bottom of the ventral base to the tip of the scute below it less than one-half an eye diameter 4

4.(3) Ventral scutes 29 to 37............ 5

— Ventral scutes 38 to 41............6. *M. maculatus*

5.(4) Total number of gill rakers 21 to 30; scales bordering the naked middorsal line between the base of the occipital process and the dorsal origin about 45 to 50; lowest point in the ventral outline usually under or before the ventral origin............4. *M. lippincottianus*

— Total number of gill rakers 17 to 23; scales bordering the midline between the base of the occipital process and the dorsal origin about 55 to 65; lowest point in the ventral outline usually between ventral origin and anal............5. *M. argenteus*

1. **Metynnis luna** Cope

Metynnis luna Cope, 1878, p. 692 (Peruvian Amazon); Fowler, 1907, p. 479, fig. 58 (on the type).

Metynnis guaporensis Eigenmann, 1915, p. 267, pl. 54 (Macièl, Rio Guaporé; and San Joaquin, Bolivia).

Specimens examined: M.C.Z. 19140 in part, one, 114 mm., Silva, Lake Saraca, 1866, S. V. R. Thayer; M.C.Z. 19136 in part, one, 93 mm., Lake Hyanuary, 1866, L. Agassiz.

The general appearance of this fish is well shown in Eigenmann's (1915) plate. Museum specimens of this species resemble the others of the genus superficially, except that the operculum is somewhat more extended posteriorly. The gill rakers are far longer and more numerous than in other forms of *Metynnis,* and the difference is easily seen by casual inspection of the gill arch.

The type of this species, like other specimens described by Cope from the same collections (for example *Myletes herniarius),* seems to have been abnormally deep. This may be a peculiarity of preservation, since the fishes from the Amazon which were reported on by Cope were in notoriously poor state when received.

Counts and measurements for the specimens examined are given in table 4.

2. **Metynnis hypsauchen** (Müller and Troschel)

Myletes hypsauchen MÜLLER AND TROSCHEL, 1845, pp. 23 and 38, pl. 10, fig. 1 (Essequibo River, British Guiana); MÜLLER AND TROSCHEL, in Schomburgk, 1848, p. 637 (Tapacuma Lake, Guiana); CUVIER AND VALENCIENNES, 1849, p. 219 (Amazon and Guiana); KNER, 1859, p. 26 (Caiçara, Marabitanos); GÜNTHER, 1864, p. 376 (Essequibo River); STEINDACHNER, 1881, p. 28 (Amazon near Santarem and Tefé; Rio Trompetas and Rio Guaporé).

?Myletes (Myleus) orinocensis STEINDACHNER, 1908, p. 365 (Orinoco near Ciudad Bolivar).

Metynnis hypsauchen, EIGENMANN, 1912, p. 389 (British Guiana); AHL, 1924, p. 21 (Guiana, Bolivia, and Rio Jamundá near Faró); NORMAN, 1929, p. 819 (Guiana, Amazon).

Metynnis calichromus AHL, 1924, p. 18, fig. 1 (Lago de Faró, Jamundá).

Metynnis calichromus schreitmülleri AHL, 1922, (not seen).

Metynnis schreitmülleri AHL, 1924, p. 19 (Amazon).

Metynnis ehrhardti AHL, 1926, p. 273 (Mundurucú, on Rio Manacapuru, Solimoes, State of Amazonas).

Metynnis fasciatus AHL, 1931, p. 407, fig. p. 409 (Rio Capiuru).

Material examined: M.C.Z. 19140 in part, seventeen, 87-123 mm., Silva, Lake Saraca, 1866, S. V. R. Thayer; M.C.Z. 30126, one, 76 mm., Rockstone, Essequibo River, British Guiana, 1908, C. H. Eigenmann; C.M. 5732 a-d, four, 108-130 mm., Santarem, Dec. 15, 1909, J. D. Haseman; C.M. 5733 a-b, two, 53 and 73 mm., Manaos, Nov. 29, 1909, J. D. Haseman: C.A.S. 20226, 106 mm. and U.M.M.Z. 144340, 106 mm., two, Santarem River, Aug., 1924, C. Ternetz; C.A.S. 20225, one, 58 mm., Fazenda Sta. Cruz, Lagoa Grande into Amazon, Hyanuary, July 15, 1924, C. Ternetz.

This is the species of *Metynnis* most commonly met with in collections. It seems also to have the widest distribution in the genus with the possible

TABLE 4

Ranges and averages of counts and measurements for two species of *Metynnis*. All measurements, other than standard length, are given in thousandths of standard length.

Species	*M. luna*		*M. hypsauchen*	
Catalogue numbers	M.C.Z. 19140 in part	M.C.Z. 19136 in part	M.C.Z. 19140 in part	C.A.S. 20226 U.M.M.Z. 144340
Locality	Lake Saraca	Lake Hyanuary	Lake Saraca	Santarem River
Number of specimens	1	1	17*	2
Standard length (mm.)	114	93	87-123 (104)	106
Total number of gill rakers	60	53	26- 36 (32) [16]	31- 33
Total number of dorsal rays	19	17	18- 22 (19)	17- 18
Total number of anal rays	43	41	38- 46 (41)	39- 40
Number of pectoral rays	16	14	14- 17 (15) [8]	14
Number of ventral rays	6	5	6- 7 (6.9) [8]	7
Total number of mid-ventral scutes	27	27	26- 31 (29)	28- 29
Number of scales along mid-dorsal line between base of occipital process and origin of rayed dorsal	......	......	......	47
Number of scales along adipose base	......	......	......	......
Depth	799	903	800-895 (834)	793-849
Head	341	347	298-329 (311)	277-304
Snout	76	78	67- 92 (82)	75- 77
Eye	82	90	89-106 (97)	87- 91
Interorbital	133	138	129-146 (136)	123-131
Post-orbital part of head	183	193	144-163 (152)	140-150
Greatest width of operculum	89	100	60- 74 (68)	64- 65
Greatest depth of operculum	266	290	235-279 (253)	239-241
Length of occipital process	200	215	197-238 (220)	167-199
Distance from base of occipital process to origin of rayed dorsal	442	467	447-486 (463) [15]	470-481
Distance from tip of snout to origin of rayed dorsal	597	646	609-660 (635)	634-639
Distance from origin of rayed dorsal to end of vertebral column	626	651	607-656 (631)	616-655
Length of longest dorsal ray	......	......	254-309 (276) [14]	....
Length of dorsal base	247	245	228-261 (246)	239-246
Distance from base of last dorsal ray to origin of adipose	107	129	87-119 (103)	88-111
Length of adipose base	185	197	173-202 (191)	197-209
Depth of caudal peduncle	93	105	97-111 (104)	103-111
Length of anal base	431	493	423-478 (450)	409-419

*If range and average are based on fewer specimens, the number of specimens used is indicated in brackets.

exception of *M. argenteus,* extending at least from Guiana, through the Amazons, into the Paraguay system.

Though *M. hypsauchen* superficially resembles the other species of the genus, it is at once distinguishable by its long, low adipose. The great length of the supraoccipital process will likewise distinguish *M. hypsauchen* from all but *M. luna.* In number of gill rakers the species falls between *M. luna* and the *M. maculatus* group, only slightly overlapping the range of the latter. In color *M. hypsauchen* is plain silvery, and some specimens at least have vertical bluish bars on the upper sides.

Counts and measurements for the Lake Saraca specimens are given in table 4.

3. **Metynnis mola** Eigenmann and Kennedy

Metynnis mola EIGENMANN AND KENNEDY, 1903, p. 528 (Arroyo Trementina, Paraguay); EIGENMANN, MCATEE AND WARD, 1907, p. 141, pl. 42, fig. 1 (Puerto Murtinho, Río Paraguay and Río Otuquis, a western tributary of the Río Paraguay).

Metynnis otuquensis AHL, 1924, p. 26 (Bahia Negra, Río Otuquis).

Material examined: C.M. 10050, paratype, 64 mm., from Arroyo Trementina, tributary to Río Aquido Canigi, Río Paraguay drainage.

This species, as exemplified by the specimen examined, differs from the rest of the *M. maculatus* group chiefly in the far greater development of the ventral scutes. These somewhat resemble the ventral scutes of *Mylossoma* in their vertical elongation and in their considerable projection beyond the skin of the abdomen. Furthermore, the forked scutes which occur behind the ventral origin have the prongs of the fork extending more or less vertically and parallel to one another rather than, as in other species, flaring out into a more or less double ended anvil.

Counts and measurements for the specimen examined are given in table 5.

4. **Metynnis lippincottianus** (Cope)

Myletes lippincottianus COPE, 1871, pp. 561, 566, fig. (Pará).

?*Myletes lippencottianus* (sic), ULREY, 1895, p. 299 (Brazil).

Sealeina lippincottianus, FOWLER, 1907, p. 479, fig. 57 (Pará).

Metynnis (Myleus) orbicularis STEINDACHNER, 1908, p. 364 (Rio Parnahyba near Victoria and Santa Filomena, and Santarem).

?*Metynnis goeldii* EIGENMANN, 1910, p. 443 (based on *Myletes lippencottianus,* Ulrey, 1895).

Metynnis roosevelti EIGENMANN, 1915, in part, p. 268, pl. 55 (Manaos and Santarem).

Metynnis seitzi AHL, 1924, p. 28 (aquarium specimen, probably from the Amazon).

Material examined: C.A.S. 20227, one, 76 mm., Fazenda Sta. Cruz, Lago Grande into Amazon, Hyanuary, July 15, 1924, C. Ternetz; C.A.S. 20228, 123 mm. and U.M.M.Z. 144345, 90 mm., two, Santarem market, Sept., 1924, C. Ternetz; C.A.S. 20229, one, 117 mm., Santarem market, Oct., 1924, C. Ternetz.

Of the species listed in the synonymy, the only description of *M. goeldii* runs as follows (Ulrey, 1895, p. 300): "Two specimens from Brazil. The dorsal has a conspicuous black blotch on the upper part of the first rays and the ventrals are dark colored." Dr. Raney has been good enough to look for, but could not find, Ulrey's specimens, which are presumably at Cornell with the rest of the material reported on by Ulrey.

Metynnis lippincottianus, well illustrated by Eigenmann (1915, pl. 55) under the name *M. roosevelti*, differs from *M. maculatus* in the fewer ventral scutes, and from *M. mola* in the lesser prominence of these scutes. From *M. argenteus*, to which it is very closely related, it may be distinguished by the ensemble of characters stated in the key; of these, perhaps the best single character is the greater number of gill rakers in *M. lippincottianus*. The scales, though definitely larger than in *M. argenteus*, are very difficult to quantify. In many museum specimens they are missing altogether, at least from the midsides. In those specimens which have the scales present, they do not seem to be laid down in regular rows, and only a very rough approximation is possible. Such an approximation in a specimen 117 mm. from Santarem is 80 transverse rows, with 33 scales between the lateral line and the dorsal and 35 between the lateral line and the ventral bases. Another count on the same fish would probably vary by 5 scales from the above, while the scale number on different specimens seems to show much wider variation.

Besides the characters given in the key, *M. lippincottianus* seems to be less deep-bodied than *M. argenteus*. The snout is usually shorter, the interorbital narrower, and the dorsal profile above the eyes is more evenly convex, i. e., less indented. The dorsal rays in the specimens at hand are usually more numerous, and the spotting of the sides generally is far more prominent than in *M. argenteus*.

Counts and measurements for this species are given in table 5.

5. **Metynnis argenteus** Ahl

Metynnis maculatus Eigenmann *(non* Kner), 1912, p. 390, pl. 57, fig. 1 (Lama Stop-Off, Rockstone, and Twoca Pan, British Guiana).

Metynnis argenteus Ahl, 1924, p. 24 (Rio Tapajos, near Borin).

Metynnis eigenmanni Ahl, 1924, p. 25 (Rio Tapajos, near Borin); Norman, 1929, p. 819 (Amazon).

Metynnis anisurus Ahl, 1924, p. 27 (Rio Tapajos, near Borin).

Metynnis altidorsalis AHL, 1924, p. 22 (Paramaribo, Surinam).

Metynnis heinrothi AHL, 1924, p. 29 (aquarium specimen, probably from the Amazon).

Metynnis snethlageae AHL, 1924, p. 30 (Amazon).

Material examined: M.C.Z. 19136 in part, twenty-seven, 65-145 mm., Lake Hyanuary, 1866, L. Agassiz; M.C.Z. 19140 in part, three, 110-138 mm., Silva, Lake Saraca, 1866, S. V. R. Thayer; C.A.S. 20228, 125 mm. and U.M.M.Z. 144346, 106 mm., two, Santarem market, July, 1924, C. Ternetz; C.A.S. 20231, one, 94 mm., Santarem River, Aug., 1924, C. Ternetz.

This species seems to have been described several times by Ahl, though so far as I can determine it had not been named previous to his revision. The difficulty of distinguishing this form from *M. lippincottianus* makes the synonymies of both of them somewhat tenuous, as is in fact the specific distinction between the two. *Metynnis argenteus* often appears to be unspotted throughout life. On the other hand, traces of spots on the sides seem to be identifiable on some of the Hyanuary material which I have determined as this form. An approximation of the scale counts in a Santarem specimen 125 mm. in standard length is 95 transverse rows, with 50 scales between lateral line and dorsal origin, and 61 between lateral line and ventral origin.

Both males and females are represented among the larger specimens, at least, of the Hyanuary material of this species.

For a comparison of *M. argenteus* and *M. lippincottianus* see the latter species and table 5.

6. **Metynnis maculatus** (Kner)

Myletes maculatus KNER, 1859, p. 26 (Rio Guaporé); STEINDACHNER, 1881, in part, p. 128 (on the type).

Metynnis roosevelti EIGENMANN, 1915, in part, p. 268 (Bastos, on the Rio Alegre, a tributary to the Rio Guaporé); PEARSON, 1924, p. 48 (Lagoon near Reyes).

Material examined: U.M.M.Z. 66457-66460, four, 88-117 mm., Lagoon near Reyes, Bolivia, Oct., 1921, N. E. Pearson. This is part of the material reported on by Pearson in 1924.

Four closely related species seem to be represented in the *Metynnis maculatus* complex. Of these *M. maculatus* occurs in the Rio Madeira system, *M. mola* in the Paraguay, *M. lippincottianus* in the Amazon, and *M. argenteus* in Guiana, the Amazon, and probably in the Paraguay. It is possible that some of these forms will eventually prove to be geographical subspecies of one another, but too little is known about them to more than suggest such a hypothesis at the present time.

TABLE 5. Ranges and averages of counts and measurements for four species of *Metynnis*. All measurements, other than standard length, are given in thousandths of standard length.

Species	*M. mola*	*M. lippincottianus*	*M. argenteus*			*M. maculatus*
Cat. nos.	(paratype) C.M. 10050	C.A.S. 20227, 20228, 20229 U.M.M.Z. 144345	M.C.Z. 19136 in part	M.C.Z. 19140 in part	C.A.S. 20230, 20231 U.M.M.Z. 144346	U.M.M.Z. 66457-66460
Locality	Arroyo Trementina, Paraguay	Hyanuary (1) Santarem market (3)	Hyanuary	Lake Saraca	Vicinity of Santarem	Reyes, Bolivia
No. of specimens	1	4	27†	3	3	4†
S.L. (mm.)	64	*76**-123 (102)	65-145 (110)	110-138 (122)	94-125 (108)	88-117 (96)
Tot. no. of gill rakers	23	21- 25 (24)	17- 23 (20)	19- 22 (21)	19- 22 (20)	21- 25 (22)
Tot. no. of dor. rays	15	14- 16 (15)	16- 20 (18)	18- 19 (18)	15- 19 (17)	16- 18 (17)
Tot. no. of anal rays	40	39- *41* (40)	35- 43 (40)	37- 38 (38)	36- 39 (37)	39- 42 (40)
No. of pect. rays	14	14- 16 (15)	15[3]	14- 15 (14)	12- 15 (14)	15- 16 (15)
No. of vent. rays	5	5- 6 (5.8)	5- 7 (6.1)	7 (7)	6 (6)	6 (6)
Tot. no. mid-vent. scutes	36	*31*- 37 (34)	29- 36 (33)	32- 33 (33)	30- 33 (32)	38- 41 (40)
No. scales bet. base occ. process & or. rayed dor.	......	37- 52 (45)	57- 61[3]	......	59- 65 (61)	47- 56 (52)
No. scales along ad. base	......	16- 20 (18)	20- 25[3]	......	30- 33 (32)	16- 22 (20)
D.	858	667-822 (758)	762-884 (801)	783-832 (802)	807-867 (842)	712-738 (723)
H.	297	262-289 (276)	272-312 (288)	280-297 (289)	284-294 (288)	273-285 (280)
Sn.	78	56- 78 (67)	66- 87 (76)	67- 83 (76)	72- 76 (74)	69- 77 (74)
Eye	111	76- *93* (84)	76-103 (86)	86- 96 (91)	88- 96 (91)	76- 92 (86)
Interorb.	127	121-141 (129)	122-149 (132)	136-142 (139)	137-141 (139)	121-126 (123)
Post-orb. part of H.	133	138-144 (140)	117-156 (143)	122-142 (135)	140-149 (144)	134-146 (142)
Greatest width of oper.	70	*63*- 88 (73)	59- 98 (80)	63- 67 (65)	65- 73 (66)	65- 69 (67)
Greatest depth of oper.	229	212-234 (223)	218-251 (230)	216-231 (225)	219-233 (228)	219-235 (226)
L. of occ. process	173	119-152 (139)	130-183 (153)	158-163 (161)	157-167 (162)	144-150 (148)
Dist. from base of occ. process to or. rayed dor.	456	435-*476* (457)	425-501 (468)	419-449 (432)	424-473 (455)	422-447 (435)
Dist. from tip of sn. to or. rayed dor.	638	596-*652* (626)	597-684 (645)	606-646 (625)	623-662 (649)	601-632 (614)
Dist. from or. rayed dor. to end of vert. column	654	587-621 (598)	582-687 (617) [25]	605-617 (610)	620-633 (629)	587-610 (600)
L. of longest dor. ray	....	242-368 (309)	266-392 (349) [10]	327-373 (343)	256-437 (337)	280-355 (318) [2]
L. of dor. base	214	208-243 (221)	205-245 (231) [24]	238-252 (247)	222-247 (238)	223-245 (230)
Dist. from base of last dor. ray to or. of ad.	141	*107*-139 (120)	106-161 (132)	101-144 (117)	125-133 (129)	110-127 (116)
L. of ad. base	145	*133*-162 (150)	138-174 (155)	149-159 (153)	144-175 (158)	131-156 (146)
D. of caud. ped.	109	113-130 (119)	98-161 (114)	108-115 (112)	113-117 (114)	101-109 (105)
L. of anal base	502	392-*480* (431)	398-447 (420)	396-427 (410)	401-471 (444)	382-421 (398)

* Extreme of range in italics when it is the measurement of the Hyanuary specimen.

† If range and average are based on fewer specimens, the number of specimens used is indicated in brackets.

Metynnis maculatus differs at once from the other three in the greater number of ventral scutes. In other respects it is more or less intermediate between *M. lippincottianus* and *M. argenteus*. The absence of further differentiating characters might suggest that the scute number is an individual variation rather than a specific character. However, the high scute count found in the Reyes material is also recorded for Eigenmann's (1915) specimens from Bastos on the Rio Alegre, a tributary of the Rio Guaporé; for three specimens from the latter locality scute counts of 38, 38, and 42 are given. The counts given by Kner in his original description of the species are 33-35 simple plus 2-4 paired scutes. By contrast the abdominal serrae in 45 specimens of the other three related species examined range between 29 and 37.

This species, so far as known, is limited to the Madeira drainage.

Counts and measurements for specimens examined are given in table 5.

VIII. **Catoprion** Müller and Troschel

Teeth 5/6, tuberculate, widely spaced in a single very irregular row both above and below; no teeth on maxillary. Gill rakers 8/12, spiny; branchiostegals 4-4; first two exposed suborbitals much deeper than the others (fig. 5e). Abdominal scutes about 32; scales small. Predorsal spine well developed; dorsal rays about 17, the first few elongate; adipose rather long; anal about 37.

One species, *C. mento,* from the Amazon and Guiana.

Of the stomachs of four specimens examined, two were full of fish scales and two were empty except for a few fish scales; a small amount of unidentifiable debris was also found.

The general appearance of this peculiar fish is well shown in Eigenmann's plate (1912, pl. 56, fig. 3). The teeth are accurately illustrated by Müller and Troschel (1845, pl. 2, fig. 5).

IX. **Pygopristis** Müller and Troschel

The diagnosis of this genus is the same as that for *Serrasalmus.* The species of *Serrasalmus* grade imperceptibly into *Pygopristis,* and the distinction between the two, based on the number of tooth lobes, seems of doubtfully generic rank.

One species, *P. denticulatus,* from Guiana and the Amazon, is attributed to the genus by Norman (1929).

X. **Serrasalmus** Lacépède

Teeth 6/7, shearing; no teeth on maxillary. Gill rakers rudimentary; branchiostegals 4-4; 3 exposed suborbitals (fig. 5d). Abdominal scutes

22-37; scales small. Predorsal spine present; dorsal rays 14-20; adipose small, rayed in adults of *S. piraya;* anal 29-37. (Most of these counts are from Norman.)

Sixteen species recognized in Norman's (1929) revision.

To the described species dealt with by Norman, add *Serrasalmus boekeri* AHL, 1931, p. 406, fig. p. 408 (locality not stated, probably lower Amazon).

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